Digital Digest

Vol. 2 No. 4 **Devoted entirely to Digital Amateur Radio Communications** July/August, 1989

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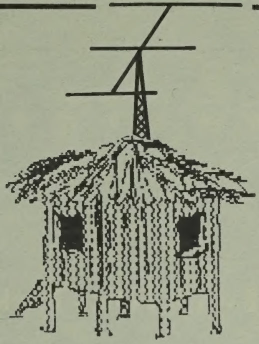
PROGRAMMER'S Notebook...
Pete Smith, N4ZR
discusses more programming applications in amateur radio and reviews EASYDX, a new realtime logging program specifically designed for HF DXers...

There's all this, and a whole lot more in this issue!



From The Publisher's Shack

At first glance, this issue has a striking resemblance to the May/June publication. Rest assured however that the contents are all new. The reason for the strong resemblance to the last issues cover is that:

a.) The printing deadline approached with no new artwork
b.) I kinda like the artwork and am thinking of keeping it as part of our front page format
c.) I am thinking of replacing the front page art with photos submitted by readers of their shacks, etc...
d.) All of the above

(cont'd page 3)

Connect your computer to a new world of adventure . . .

AMATEUR RADIO!

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Others May Try to Imitate, But...

Only One Can Be The Best

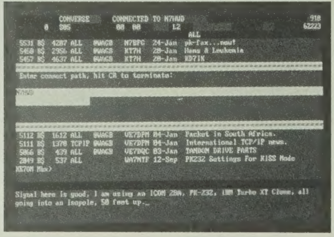
Morse Code - Baudot - ASCII - AMTOR - Packet - Facsimile - Navtex

It's a lesson you learn very early in life. Many can be good, some may be better, but only one can be the best. The PK-232 is the best multi-mode data controller you can buy.

1 Versatility

The PK-232 should be listed in the amateur radio dictionary under the word Versatile. One data controller that can receive seven digital modes, and can be used with almost every computer or data terminal. You can even monitor Navtex, the new marine weather and navigational system. Don't forget two radio ports for both VHF and HF, and a no compromise VHF/HF/CW internal modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold control.

The internal decoding program (SIAM^{tm)} feature can even identify different types of signals for you, including some simple types of RTTY encryption. The only software your computer needs is a terminal program.



```
        CONVERSE      CONNECTED TO N7HWD                                918
      0  S05            00  00       12                               62223
                                          ALL
5531 B$  4287 ALL    0WAGB   N7BFG  24-Jan  pk-fax...now!
5458 B$  2956 ALL    0WAGB   KT7H   28-Jan  Hams & Leukemia
5457 B$  4637 ALL    0WAGB   KT7H   28-Jan  KD7IK
Enter connect path, hit CR to terminate:
N7HWD
5112 B$  1612 ALL    0WAGB   VE7DPM 04-Jan  Packet in South Africa.
5111 B$  1370 TCPIP 0WAGB   VE7DPM 04-Jan  International TCP/IP news.
5066 B$   439 ALL    0WAGB   VE7DQC 03-Jan  TANDON DRIVE PARTS
2049 B$   537 ALL            WA7MTF 12-Sep  PK232 Settings For KISS Mode
KE7OM Msg>
Signal here is good, I am using an ICOM 28A, PK-232, IBM Turbo XT Clone, all
going into an Isopole, 50 feet up._
```

PC Pakratt Packet TX/RX Display

Facsimile Screen Display

2 Software Support

While you can use most modem or communications programs with the PK-232, AEA has two very special packages available exclusively for the PK-232....PC Pakratt with Fax for IBM PC and compatible computers, and Com Pakratt with Fax for the Commodore 64 and 128.

Each package includes a terminal program with split screen display, QSO buffer, disk storage of received data, and printer operation, and a second program for transmission/reception and screen display of facsimile signals. The IBM programs are on 5 1/4" disk and the Commodore programs are plug-in ROM cartridges.

3 Proven Winner

No matter what computer or terminal you plan to use, the PK-232 is the best choice for a multi-mode data controller. Over 20,000 amateurs around the world have on-air tested the PK-232 for you. They, along with most major U.S. amateur magazines, have reviewed the PK-232 and found it to be a good value and excellent addition to the ham station.

No other multi-mode controller offers the features and performance of the PK-232. Don't be fooled by imitations. Ask your friends, or call the local amateur radio store. We're confident the PK-232 reputation will convince you that it's time to order your very own PK-232.

Call an authorized AEA dealer today. You deserve the best you can buy, you deserve the PK- 232.

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The DIGIPEATER

News & Information

communicated from various sources.

(cont'd from front page)

Actually, d.) is the correct answer. I feel the art on D-D's front cover does a pretty good job of depicting what the publication is all about. However, we might create more interest (and less confusion from issue to issue) by showing a different photo or graphic every month.

Thoughts are to solicit photos from readers at the controls of their digitally equipped shacks. So, if you would like to get a little front page exposure, why not send us a photo of your shack and a brief description of yourself, occupation, operating activities, etc. Who knows... Digital Digest today -- Time Magazine tomorrow!? We prefer a photo you can part with. If you do wish the photo returned, please be sure this is prominently noted. Black and white photos are best for reproduction, however our graphics department can make just about anything work. No amount of artistic wizardry though can compensate for out-of-focus shots... so please make sure your submissions are as sharp as possible.

On another note, we have begun a new column "Software Corner." The column is intended to be a sounding board of sorts for software users and publishers to present more in-depth information on the use, operation and performance of the vast array of programs designed for the amateur market.

That's about it for me here, hope you're enjoying the publication and I look forward to "seeing you" soon...

73's, Tom / WA8DXD

More BBSs...

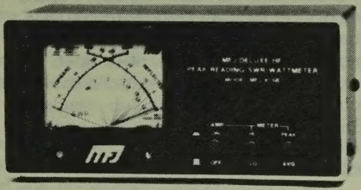
are serving amateur radio. The Kenwood Communications & Test Equipment Group is a new open amateur radio BBS accessible to any ham with a computer and modem. System parameters are: 300/1200/2400 baud, 8 bits, 1 stop bit and no parity. BBS features amateur information, news and programs. Access at (213) 761-8284. Operating hours are 5:00pm to 8:00am Pacific Time Monday-Friday and 24 hours per day on weekends and holidays.

73 MAGAZINE again has its amateur radio bulletin board service in operation. The system was quite popular a few years ago but went away during a change in editorial staff at the magazine. It is back again and can be reached at (603) 525-4438. It operates at up to 1200 baud. Parameters are 8, none, and 1 stop bit.

- Source: Westlink Report -

MFJ Enterprises, Inc. ...

announces the release of of a new "peak" and average reading Cross-Needle SWR/Wattmeter.



The MFJ-815B lets you monitor SWR, forward and reflected power... all at a single glance. You can select from two power ranges for forward and reflected power (2000 watts forward and 500 watts reflected or 200 watts forward and 50 watts reflected). It shows you SWR from 1:1 to 8:1.

The MFJ-815B covers 1.8 to 30 MHz with 10% accuracy. It comes with MFJ's full one year No Matter What(tm) guarantee. That means MFJ will repair or replace your MFJ-815B (at their option) no matter what happens to it for a full year. Lighted meter requires 12 VDC or 110 VAC with MFJ-1312 ($12.95). Price of the MFJ-815B is $69.95.

For more information contact any MFJ dealer or MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762, or call (601) 323-5869. To order, call toll free at 800-647-1800.

AEA Announces PK-88 Firmware Upgrade...

On May 16, 1989, AEA introduced a firmware upgrade for the PK-88 data controller. This is the first upgrade for the PK-88 since its introduction in July 1988. With this update, we have included several new commands. The following provides a summary of the changes.

1. Added the command WHYNOT. Occasionally packet data is received by the PK-88 but not displayed on the screen. Activating WHYNOT causes the PK-88 to generate a message explaining whyy the data was not displayed.

2. Added the command CUSTOM. By changing the value in the CUSTOM parameter, some customizing of the PK-88 is possible.

3. Turning KISS on sets all packet parameters for TCP/IP operation.

4. When in a packet link, all leftover data will not be transmitted as UI frames should a disconnect occur.

5. MBX has been enhanced to accept the argument of ALL.

6. Added a Morse ID in the packet mode (required in England). This is NOT required in the United States, and it is advised to leave this setting at zero.

If your PK-88 was purchased after April 16, 1989, you may already have the new firmware installed. Check your manual for a supplement outlining the new commands. If the new commands are not included, contact AEA for special instructions to receive the upgrade at no charge. If you purchased your PK-88 prior to April 16, 1989, the cost of the upgrade is $30 plus $5 shipping and handling. If you have any questions regarding the PK-88 upgrade, please call AEA at (206) 775-7373.

Packet Aids Emergency Operations...

Some rain, mostly scattered showers, were all that came from an ominously overcast Connecticut sky on Monday, July 10, 1989. The National Weather Service had issued a Severe Thunderstorm Warning but nothing had been said about tornados.

Personnel at the State Office of Emergency Management (OEM) knocked off work at 4:30 pm, as usual. State Communications and Warning Officer Ken Lappe, KA1SJ, shifted the state warning point to the state police communications center and cautioned them to watch the weather teletype.

We ate early that evening and it was fortunate. Shortly before 6 pm I got a call to report to the state Emergency Operating Center (EOC). Ken was on his way. On the OEM radio, he told me there was severe storm damage in several towns, worse in Hamden and New Haven.

"Bring up the packet station first in monitor mode," he said. "Then you'll have to shift the CAP radio to the two-meter Amateur band."

That let us monitor the 146.61 voice repeater in New Haven, where an emergency net was already in operation. Net Control was set up at the Command Post, right in the middle of the intersection of Dixwell and Ash. Automobile traffic wasn't a problem because cars couldn't get through anyway. An amateur was already at the triage center in Hamden High School and other sensitive positions were being covered.

Because of the fast response of Amateurs, we were able to get an immediate casualty count (fortunately, zero) for the State Director of Emergency Medical Services from the triage center where his

(cont'd on page 15)

Digital Digest -PACKET

by Lynn W. Taylor, WB6UUT

463 Myrtle Street • Laguna Beach, CA 92651

★ A Look At AX.25 ★

For the last few articles, we've been looking at protocols in general: Aloha and it's variants in the first radio-based network, and a quick look at the ISO Open Systems Interconnect model.

This time, we're going to get down to Amateur Packet Radio in it's current state: AX.25.

Before I raise the ire of the TCP/IP gang, let me just say that under current FCC rules, TCP/IP must run inside AX.25 if any third party traffic is to be handled. We'll see what September brings when the Part 97 re-write takes effect.

AX.25 is operates on Layer 2 of the ISO model. Layer 1 as adopted by VADCG, TAPR and others has to date used 1200 baud Bell 202 modem tones into voice radios, but this is not a part of the AX.25 specification, and may be changed.

A generalized AX.25 packet is shown in figure 1.

flag	address	control	PID	information	check	flag

figure 1: AX.25 frame format

Flags mark the beginning and end of each frame. The flag pattern (in binary 01111110) will never occur in the middle of a frame due to "zero stuffing" -- if five ones occur in a row, the next bit is always a zero, and is always discarded. The end flag for one frame may also be the beginning flag for the next frame, it is not necessary for the TNC to send two flags.

The next field is the address field, and is at least fourteen bytes long. We can break this field into seven byte subfields as shown in figure 2.

Call sign (six bytes)	Cmd./Resp. (1 bit)	Reserved (2 bits)	Sub-stn. ID (4 bits)	Addr. Ext. (1 bit)

SSID byte

figure 2: Address field (occurs 2 to 10 times)

The first six bytes of the address is the amateur call sign of the sending station in ASCII. Uppercase characters are always used (i.e. WA8DXD not wa8dxd), and if the call sign is less than 6 characters, spaces are added at the end as needed.

An added "twist" -- the ASCII characters are placed in the top seven bits of each byte, with the low order bit set to zero. The low order bit serves to mark the end of the address section, and is set to one only in the last station's SSID byte.

The seventh byte is the SSID byte. This byte contains the "dash number" at the end of a call sign, and ranges from 0 to 15. The high order bit is the command/response bit, and is described later, the next two bits are reserved and presently unused, then the four bit sub-station id (SSID) itself, and finally the address extension bit, which is zero for all but the last byte of the address part.

The AX.25 specification calls for at least 2 addresses (sender and receiver) plus up to 8 repeater (digipeater) addresses.

In the digipeater address, the command/response flag becomes the "has been repeated flag." If zero, this frame has not been repeated by the station, if one, the frame has been received by the addressed digipeater and retransmitted. Aside from changing the "has been repeated flag," digipeaters retransmit the frame exactly as received.

Unlike Layer 3 nodes which can retry on a hop-by-hop basis, if the acknowledge frame gets lost on the last transmission of an 8 digipeater path, recovering from the error requires eighteen transmissions for end-to-end error correction. For this reason, the AX.25 specification calls digipeating a "temporary method" of extending the range of individual stations.

Digipeaters only repeat a frame if they are "next" to relay the packet. In other words, a digipeater will retransmit a frame if it is the first digipeater listed whose "has been repeated" bit is zero.

The control byte follows, which tells what type of frame is being sent. Frames are divided into three groups: Information (I frames), Supervisory (S frames) and Unnumbered (U frames) frames.

I frames carry the actual data during a connection. The first three bits of the control byte is the number of the current frame, which ranges from zero to seven. The next bit is the Poll flag -- which tells the receiver to respond to this frame immediately. The next three bits contain the number of the next frame expected from the other station, again from zero to seven. If this field contains 6, the receiver knows that all currently outstanding frames through frame 5 were received. The low order bit is always zero.

The frame numbers always range from zero to seven, allowing up to 8 frames to be tracked at any given time, and up to seven frames to be transmitted. When frame seven is sent, the next frame is always frame zero.

S frames are used to "supervise" the link, requesting retransmission of a missed frame, or acknowledging the receipt of a frame. The first three bits give the last correctly received frame's number, followed by the poll/final flag, then two bits for the type of frame, and the last two bits are 01, indicating a supervisory frame.

If in the address field the command bit is 1, the poll/final bit is a poll flag. If the field is not a command, the poll/final bit is a final flag, and indicates that this frame is the response to a poll. Only one poll is allowed at a time.

As an example, if a frame has been sent and no acknowledge has been received, the sender will send an acknowledge-poll. The receiver will immediately send an acknowlege-final with the number of the last received frame. The two stations are now back in synchronization.

Supervisory frames are Received-Ready (RR), Received-not Ready (RNR) and Reject (REJ). Received-Ready and Received-not Ready are both acknowledges. If an RNR is received, the other TNC is "full" and the sender waits until it can make room by sending data to the terminal or computer, while RR means room is available. Reject frames indicate a frame was received out of order (usually one was missed) and the sender should back up to the specified frame.

U frames include the SABM (connect), DISC (disconnect), DM (disconnected mode), UA (unnumbered acknowlege), FRMR (frame reject) and UI (unnumbered information) frames. SABM and DISC are used to establish or break a connection, with a UA frame sent as a response. DM is sent when a frame is sent (other than a SABM) and no connection exists. UI frames are used as broadcasts.

The Protocol ID is 11110000 ($F0) for normal AX.25 (no layer 3), 11001111 ($CF) for connections between NET/ROM stations and 11001100 ($CC) or

(cont'd on page 11)

TNC SQUELCH REPLACEMENT

On packet radio, as on phone, almost everyone uses the radio's built-in squelch. On phone, the squelch keeps the operator from hearing noise between breaks in reception. On packet, it keeps the noise away from the modem. Noise to most packet modems constitutes a busy channel and thus keeps the TNC from transssmitting. The squelch must therefore be used since the TNC will only transmit on a clear channel. Unfortunately most squelch circuits introduce long delays. After all, they were designed for phone operation and not for rapid data transmissions.

This delay has certain disadvantages which may not be recognized immediately:

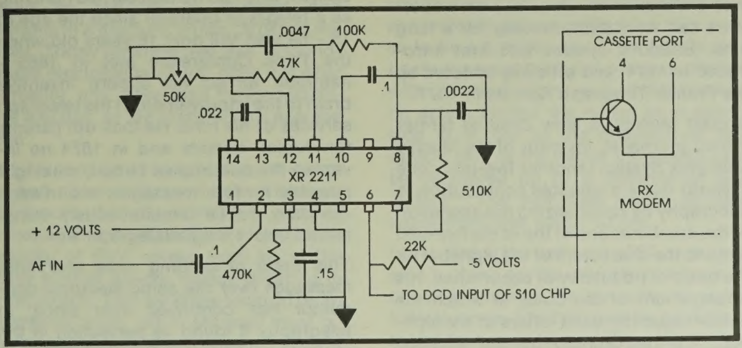
The number of packet collisions increases, even between stations able to clearly hear one another, especially with short packets. When Station A starts transmitting, Station B starts transmitting. The result is a collision and unnecessary retransmissions.

Another disadvantage is a much too long TXDELAY of usually 300 ms. With the squelch disabled, most radios could work with a TXDELAY of 70, or 150 ms with an external amplifier. With short packets, a significant amount of on-air time can thus be saved, (up to 50%). A REJECT packet, for example, consists of more than 50% TXDELAY!!

Unfortunately, a modem using the AM7910 or TCM3105JL does not care whether it detects a valid signal or noise, either way it detects a busy channel. The reason behind this is the fact that neither modem circuit was designed for radio usage. There is one chip, however, which is frequently used as a packet radio modem, namely the EXAR 2211. Assuming a properly designed circuit, users of such a modem can disable their radio's squelch without blocking their transmitters. This chip is able to distinguish between noise and signals, treating FM noise as a clear channel. The AF sensitivity is nearly identical to that of the AM7910 or TCM3105. It can also detect signals which are too weak to be decoded. Thus the XR2211 will never release the channel with signals present. So why not combine the XR2211's features with the good demodulation results of the AM7910 or TCM3105? This is exactly what I have done in my TNC2, which contains a TCM3105 modem chip. It works great, the squelch is left open, and the number of packet collisions have noticeably decreased. As an added benefit, users of the DBOME digipeater, where this modem is installed, can work with a TXDELAY of less than 100. Additionally, no interference or carrier can block the channel.

Be sure to set SOFTDCD OFF when using the XR2211. The circuit shown below will work fine with just about any TNC on the market. If the TNC uses the Zilog 8530 HDLC controller instead of the Z80 SIO (as does the PacComm TNC-200), the XR2211 pin 5 must be used for DCD output instead of pin 6. The total cost of this circuit is negligible compared to any packet radio station and it should be employed in all TNCs.

The operating voltage must be at least 12 volts. The XR2211 will not operate properly below 12 volts. With FM noise present, the DCD LED must not be on. The pot is adjusted so that the DCD LED is lit with the signals in the range of 800 to 2600 Hz. This is all the alignment that is needed. If the bandwidth is to be limited to, say, 200 Hz, the resistor between pins 11 and 12 of the XR2211 must be increased by the appropriate factor, in this case approximately 220K. This circuit is also well-suited for HF operation; most HF rigs do not have any squelch anyway.



Above article and circuit written by: Thomas Rathmann, DL1EBQ appearing in the DIGI BBS Newsletter.

Article submitted to D-D by:
Craig Rader, N4PLK
922 Baltimore Drive,
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Digital Digest —PACKET

by Norman Sternberg, W2JUP
279 Adirondack Drive • Farmingville, NY 11738

A Brief History Of Digital Communications

(This historical material was originally prepared as background information for a series of seminars in packet transmission and data communications presented by the writer to various Bell Operating Companies while working at Siemens Data Switching Systems, Inc. Much of the following historical information was drawn from the official archives and files of the International Telecommunications Union (ITU), during visits to its World Headquarters at Geneva. - W2JUP)

The International Telecommunications Union is an agency of the United Nations, founded in Paris in 1865. As a function of its technical and non-political nature, the ITU attempts to coordinate telecommunications operations and protocols between the nations of the world. The ITU Archives contain accurate records all of the significant advances, developments and patents in the communications arts and sciences during the last 100 years.

These ITU archives are generally recognized as non-political in nature, and are usually accepted as an authoritative source of information on the history of the telecommunications industry.

Because some of the information found in the ITU Archives may not agree with what is taught in the American school systems and possibly even appear to be controversial, the following statements drawn by me from records in the ITU Archives are presented without further comment or editorial opinion by the writer. The reader can best judge the merits of the arguments presented herein.

IN THE BEGINNING...

The first step in the direction of of plain language telegraphy came in 1855, 10 years before the Paris Conference, when David E. Hughes was granted a patent for a new telegraph. His apparatus was used mainly in Europe, as the patent position in the U.S.A. prevented him from exploiting his invention here. Hughes' French partner, Gustave Froment, brought the new telegraph to a high state of perfection; however, its mechanical parts were complex and often broke down. Even so, it was a great advance over the Morse system which could send only 25 words per minute. Even the early types of the Hughes telegraph achieved between 40 and 45 words per minute.

The principle of the Hughes telegraph was simple. A continually rotating wheel had 28 letters of the alphabet and other signs on it. A clutch mechanism actuated by an electromagnet brought the wheel momentarily to rest when the desired letter was over a moving strip of paper. Ink was continually fed to the type wheel from a roller, and thus a message in plain language could be spelled out straight onto the receiving paper. For sending a message, the operator had a piano keyboard in front of him, which relayed the electric impulses to the receiving post. These pulses stopped the type wheel at the correct instant of time. Over the decades, the modern automatic telegraph printer has grown from this basic principle, but only after many improvements in layout, design and detail.

The next step forward in telegraphy came from Emile Baudot, an officer in the French Telegraph Service. In 1874, Baudot developed the rotary distributor for telegraphy, and introduced the five-unit code using five bits to define each character, with a "start" bit and a "stop" bit to identify the beginning and end of each character. For each letter, therefore, five impulses were sent over the telegraph line, which actuated a set of five magnets at the receiving end. Baudot combined the use of the five-unit code with the time division multiplex system, thus allowing several telegraph communications to be transmitted over the same circuit.

The sending operator used a special keyboard of five keys. On the receiving side, the strip of paper passed through an electrical printer, printing out the telegram in clear language. In modern machines using these principles, a speed of 60 words per minute, or one six-letter word per second, is allowed for in the design of the telegraph, it being considered the maximum speed at which operators can work economically for a long time. Baudot's system was first introduced in 1874, and officially adopted by the French Telegraph Service in 1877.

Donald Murray, a New Zealand farmer turned journalist, inventor of the Murray Multiplex System (another five-unit code system) made a valuable contribution to telegraphy by rationalizing the allocation of the combinations of the of the five-unit code to the characters of the alphabet on the basis of frequency of occurrence. His arrangement of the code, in which the most-frequently-used letters of the alphabet are represented by the smallest number of holes in the tape, has since become the five-unit "Baudot" code in today's standard practice.

Although the United States of America had been linked to Europe by the two Atlantic cables of 1866, private American telegraph companies were not represented during the first conferences of the International Union. The first to come was a representative of the Western Union company; he went to the Berlin Conference of 1885. But the ever-increasing demands on telegraph services, in the United States as well as in Europe, led to many important technical improvements of the American telegraph system. One of the most important of these was the sending of more than a single telegraphic message over the same wire. It was Thomas Alva Edison (1847-1931), who in 1874 advanced this technique more than anyone else.

There can be little doubt that international cooperation existed on the technical level of telegraphy as early as it did on the administrative side. The results of the discussions of the technical committees of the International Telegraph Union found their way across the Atlantic to the American telegraph engineers.

The first to use a single telegraph wire for the sending of two messages, one in each direction, was a Dr. Gintl in Vienna in 1853. Without going into the technical details of his "duplex" circuit, it meant the incorporation of a balance filter in the circuit, thus making it unaffected by the signals sent out, but fully responsive to those coming in. This led to such economic advantages that many others carried on his work and improved it on both sides of the Atlantic. Artificial lines, Differential Duplex circuits, and Bridge Duplex circuits were all steps in this development.

Edison, who had himself earned his living as a telegraph operator since the age of 15 - he was still only 18 years old when the Paris Conference met in 1865 - naturally turned his superb inventive brain to the improvement of the telegraph services of his time. He took out patents for duplex circuits and in 1874 he invented the quadruplex circuit, making it possible for four messages, two in each direction, to be simultaneously transmitted over a single telegraph wire.

This trend of sending more and more messages over the same electrical conductor has continued ever since; in telegraphy it found its perfection in the multiplex system, and in telephony we can now transmit thousands of simultaneous telephone conversations over the same coaxial cable. If we think back

(cont'd next page)

(cont'd from previous page)

for a moment to the early pioneers of telegraphy, using a single separate wire for each letter of the alphabet, and compare that with the thousands of simultaneous telephone conversations, we can see at a glance how tremendously the communications engineer has contributed to the progress of civilization.

Undoubtedly, both the duplex circuit and the Hughes' telegraph were discussed at the Paris Conference of 1865. To some they might have appeared as much science fiction as Jules Verne's cannon shot to the Moon. But to others, the new ideas were a stimulus to improve the international telegraphy service both on the technical side and from an administrative point of view. The Paris Conference was certainly an outstanding event and had set the pattern for international cooperation for the next hundred years. As the delegates travelled back to their respective homes, by railway or by horse, they could certainly be proud of the work they had achieved.

ENTER THE WIRELESS...

The story of radio begins perhaps with Joseph Henry (1797-1878), an American physicist, who discovered in 1842 that electrical discharges were oscillating. A gigantic step forward was that due to James Clerk Maxwell (1831-1879), a Scottish physicist and one of the great mathematical geniuses of the 19th century. His treatise on "Electricity and Magnetism" was read as a paper to the Royal Society in 1864, and published in fully developed form in 1873. It has been called "one of the most splendid monuments ever raised by the genius of a single individual". By purely mathematical reasoning, Maxwell showed that all electrical and magnetic phenomena could be reduced to stresses and motions in a medium, which he called the ether. Today we know that this "imponderable electrical medium" does not exist in reality, any more than the geographer's equator, or the statistician's average man.

Yet the concept of an ether helped greatly, and allowed Maxwell to put forward his theory that the velocity of electric waves in air should be equal to that of the velocity of light waves, both being the same kind of waves, merely differing in wave length. This we know today to be an elemental truth, yet to Maxwell must go the honor of having first shown it to us in pure mathematical form.

In 1857 Feddersen demonstrated that if an electrical condenser is discharged into a conductor, oscillations are set up which give rise to intermittent spark phenomena. Twenty-one years later, in 1878, David Edward Hughes (1831-1900), an Anglo-American physicist, made another important discovery in the prehistory of radio and its essential components; he found that a loose contact in a circuit containing a battery and a telephone receiver (invented by Bell in 1876) would give rise to sounds in the receiver which corresponded to those that had impinged upon the diaphragm of the mouthpiece. Hughes' "microphone" consisted of a carbon rod resting in grooves of two carbon blocks; from it developed many of the early carbon microphones of both telephone and radio. In 1883, George Francis Fitzgerald (1851-1901), an Irish physicist, suggest a method by which electromagnetic waves might be produced by the discharge of a condenser.

Next we must turn to Heinrich Rudolph Hertz (1857-1894), the famous German physicist, who was the first to create, detect and measure electromagnetic waves, and thereby experimentally confirmed Maxwell's theory of "ether" waves. In his experiments he showed that these waves were capable of reflection, refraction, polarization, diffraction and interference. They corresponded precisely in their behavior to waves of light. Hertz produced his waves, soon to be called by others "Hertzian waves" from the sparks of an induction coil, and in order to study some of their properties he employed a zinc mirror. He described one of his experiments, in 1888-89, as follows:

"The height of the (parabolic) mirror was thus 2 meters, the width of its aperture 1.2 meters and its depth 0.7 meter. The primary oscillator was fixed in the middle of the focal line. The wires which conducted the discharge were led through the mirror; the induction coil and the cells were accordingly placed behind the mirror so as to be out of the way. If we now investigate the neighborhood of the oscillator with our conductors, we find that there is no action behind the mirror or at either side of it; but in the direction of the optical axis of the mirror the sparks can be perceived up to a distance of 5-6 meters". The half-wave length of this experiment was about 30 cm.

Hertz died at the early age of 37, and once said "...these are the ultimate problems of physical science, the icy summits of its loftiest range. Shall we ever be permitted to set foot upon one of these summits? We know not: but we have found a starting point for further attempts which is a stage higher than any used before". There could be no better epitaph to one of the greatest of inventors of wireless telegraphy.

But Hertz's experiments were half a century in advance of his time, and belong to the field we now call microwave optics. Many repeated them and extended them, typical among them being Edouard Sarasin (1843-1917) and Lucine de la Rive (1834-1924) at Geneva; Antonio Giorgio Garbasso (1871-1933) and Emil Aschkinass (1873-1909) at Berlin; Jagadis Chunder Bose (1858-1937) at Calcutta, and Augusto Righi (1850-1920) at Bologna. We shall see in a moment that only Righi had an indirect influence on the technology of radio, as a young Italian by the name of Guglielmo Marconi (1874-1937) was stimulated by his books and lectures.

The next most important event was a lecture given to the Royal Institution in London by Oliver Joseph Lodge (1851-1940) on June 1, 1894. It was called "The Work of Hertz and Some of his Successors", was widely reported at the time, and was to have far-reaching consequences. Lodge, Professor of Physics at the new University of Liverpool, had himself worked extensively in the field of electromagnetic waves and was the first to comment on the phenomenon of resonance or tuning. In 1898 he took out a patent on an adjustable inductance coil in the antenna circuit of a wireless transmitter or receiver, or in both, in order to tune one with the other. This patent won him a high place in the history of wireless. His sharply tuned resonance circuits were a substantial advance over Hertz's relatively primitive arrangements, but Lodge himself, like Hertz with academic commitments, had not the time to develop his ideas on wireless telegraphy and never made an attempt to transmit an intelligent signal with electromagnetic waves.

Alexander Stepanovitch Popoff (1859-1906) was one of the many who read Lodge's lecture and was inspired by it. Popoff was in 1895 lecturer in physics at the Russian Imperial Navy's Torpedo School at Kronstadt near St. Petersburg. He experimented with Branly coherers (see below), set up a receiver with a protruding wire in 1895, and read a paper about it, "On the Relation of Metallic Powders to Electric Oscillations", at the meeting of the Russian Physico-Chemical Society of April 25 (May 7, New Style), 1895. By means of this equipment, Popoff could register electrical disturbances, including atmospheric ones. In July of the same year a similar instrument with an ink recorder was installed at the Meteorological Observatory of the Institute of Forestry at St. Petersburg.

(cont'd on page 21)

by Jonathan L. Mayo, KR3T
3980 Short Hill Drive • Allentown, PA 18104

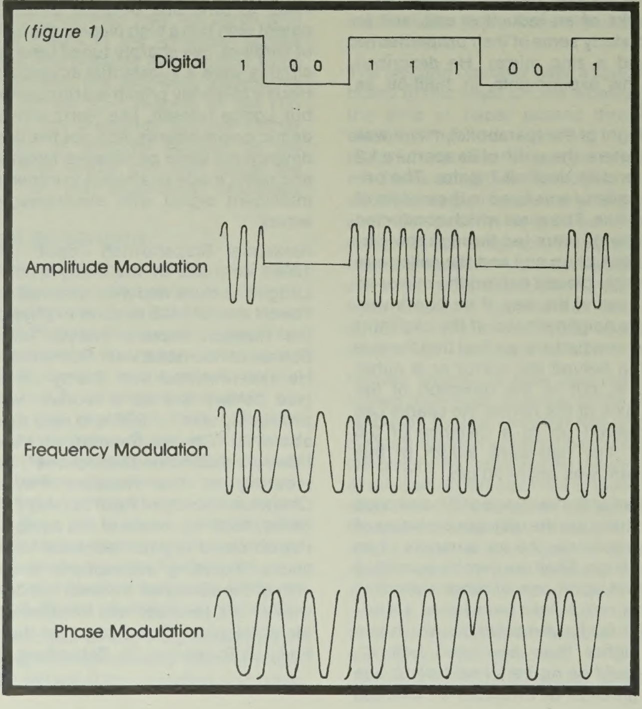
Modems In Digital Communications

The modem is an integral part of any radio-based digital communications system.

The modem (MOdulator DEModulator) converts digital signals from the communications device into analog signals for the transmitter and vice-versa. For example, in packet radio the modem interfaces between the TNC and the transceiver. There are many different types and configurations of modems.

A modem inputs bits from a digital device (such as a TNC, Terminal Node Controller) and modulates the transmitter with an analog signal (a sine wave) so that the information can be transferred via radio frequency. The modem can also receive modulated signals from the receiver and output bits whose state vary according to the content of the received signal.

There are several different modulation (and reciprocally demodulation) methods in use today. Only the frequency, amplitude, and phase components of a sine wave (See Fig. 1) can be changed for the transmission of information between modems. The forms of modulation covered in this article are Frequency Shift Keying (FSK), Audio Frequency Shift Keying (AFSK), and Phase Shift Keying (PSK). The type of modulation used determines such factors as bandwidth at a given baud rate and the type of transceiver necessary. We'll come back to the subject of modulation after we take a look at baud rate in greater detail.


(figure 1)

Baud Rate

Typically, the baud rate is generally defined as the number of bits sent per second. This definition is not entirely accurate in all cases. The baud rate is usually equal to the Bits Per Second (BPS), and the two terms are often used incorrectly as synonyms. A baud is a measure of signaling rate. A baud is actually the number of discrete events per second. For example, a 300 baud signal consists of 300 discrete events per second, and if each event represents a single bit, the BPS also equals 300 also. However, in some forms of modulation, each discrete event can represent more than one bit; thus, it is possible to have a rate of 600 or 1200 BPS from a 300 baud signal.

A discrete event is a transition from one level to another in the modulation scheme. For example, changing from a 1000 Hz signal to a 2000 Hz signal is a transition (or discrete event). If a demodulator were designed to covert a 1000 Hz signal into a 1 bit and a 2000 Hz signal into a 0 bit, we would have a two level modulation scheme. And the number of bits each discrete level represents would be 1. If we were to increase the number of frequencies to 4 (1000 Hz, 2000 Hz, 3000 Hz, and 4000 Hz) then we could represent 2 bits per event:

1000 Hz = 01
2000 Hz = 11
3000 Hz = 10
4000 Hz = 00.

It is possible to represent the above in the form of a mathematical equation:

BPS = BAUD*I. The number of bits sent per second is equal to the baud rate multiplied by the number of bits that each discrete event represents. Another example: a 1200 baud signal with each discrete event capable of representing 2 bits has a data transmission rate of 2400 bits per second.

Channel Characteristics

While we're on the subject of equations, this is as good a time as any to introduce two more that are useful when finding the data rate of a communications channel. The first equation is known as Nyquist's equation. It says that the maximum baud rate is equal to twice the bandwidth in HZ (Baud = 2*Bandwidth). For example, a 1200 baud signal requires 600 Hz bandwidth.

The Baud = 2*Bandwidth equation is actually a simplification of Nyquist's equation. The simplified equation assumes the each baud represents a single bit. In the case of a baud representing more than one bit, Nyquist's full equation is BPS = 2*Bandwidth*Log2(# of discrete levels). As you can see, as long as there is only one event per baud, the Log2(2) equals 1, and the equation becomes BPS = 2*Bandwidth*1. Since the BPS is equal to the baud rate in this case, the equation can be simplified to Baud = 2*Bandwidth as initially introduced.

But, Nyquist's equation assumes a communications channel free of noise, interference, and distortion. Because of this limitation, a communications channel will never obtain the exact characteristics obtained from the equation. It is useful as an approximation and gives an actual value for analysis even if it is very optimistic.

The next equation, Shannon's law, is somewhat more useful as it takes noise and interference into account. The amount of random and thermal noise on a channel is measured by the signal power to noise power ratio, more commonly called the signal-to-noise ratio. The signal-to-noise ratio is usually represented as S/N. The signal-to-noise ratio is included in Shannon's equation as follows:

BPS = Bandwidth*Log2(1+S/N).

More on Modulation

As mentioned earlier, a sine wave can be characterized by frequency, amplitude, and phase. Phase is useful as a signaling device only if the frequency remains constant. Since a sine wave completes a full cycle in 360 degrees, the amount of lag that one signal has compared to another one can be used to indicate a transition or discrete event.

The difference between FSK and AFSK frequency modulation has to do with the method used to transmit the generated signal. FSK is classified as direct modulation, and AFSK is classified as indirect modulation. In direct modulation, the transmitter carrier frequency is shifted up and down to transmit the analog signal. In indirect modulation, the transmitter's carrier remains stable while an external signal is superimposed upon the carrier. It is the external signal which caries, not the transmitter's carrier.

AFSK is usually easier to implement with modern transceivers as all signal generation can be done externally of the transmitter. The audio signal can be simply fed into the transceiver's Mic input. Since most transceivers do not include direct FSK ports, some modifications in usually necessary to implement FSK directly. Regardless of whether the transmitter is AFSK or FSK controlled, the transmitted signal is the same.

In (A)FSK, the frequency of the sine wave is varied to indicate transmission of a binary 1 or 0. As mentioned earlier, the bandwidth required varies according to the signaling rate, so the minimum difference or shift between the two frequencies is dependent upon the signaling rate. If a signaling rate of 200 baud is used, the frequency pairs used to represent the binary 0 and 1 might be 1000 Hz and 1200 Hz. While it is possible to have a multi-level modulation scheme using FSK, it is not normally utilized. At present, AFSK is the means of digital modulation most used in amateur radio communications. However, that may soon change as we look for methods that allow us to transmit more information through less bandwidth and under poorer channel conditions.

Phase Shift Keying offers the benefits listed above and may see increased usage in the future of amateur radio digital communications. PSK transmits information by changing the phase of the signal. If the phase is shifted between 0 and 180 degrees, it is possible to transmit information with each phase shift representing a binary character. If we were to add more phase shifts, 90 degrees and 270 degrees, we could represent two binary characters in each phase shift. For example, 0 degrees = 10, 90 degrees = 01, 180 degrees = 11, and 270 degrees = 00; each pair of binary character is called a dibit. Using the dibit, the BPS has been doubled while maintaining the baud rate.

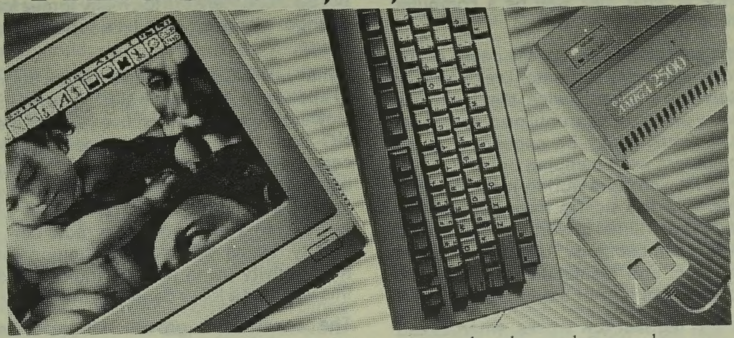
It is easy to see why PSK could be one of the modulation schemes to be reckoned with in the future. If more phases were added as some amplitude modulation were thrown in, the date rate could conceivable be quadrupled. Quaternary Amplitude Modulation (QAM) is such a form in which PSK is combined with amplitude modulation to encode 4 bits per transition. The one drawback to PSK is that it requires more complicated modem units than regular FSK.

Amateur Packet Radio Modulation Schemes

Now that you have a better idea of how modems operate, we can discuss the modem standards in use today in amateur radio. Since most of the modem development work recently has been related to packet, we'll cover packet modulation schemes in this section. There are presently two different standards, one for VHF operation and one for HF operation. Soon, and third and even fourth standard will emerge for use on VHF and UHF. But before we get too far ahead of ourselves, let's digress a little.

In the early days of amateur packet radio, the late 1970s and early 1980s, packet experimenters were looking for modems to use with their systems. They had to be cheap, reliable, and plentiful. The modems also had to be simple; the were having enough problems with the TNCs alone. The modems had to have a fairly high baud rate and be easy to interface with the rest of the system. They chose the Bell 202 standard modems because it met all of the above requirements.

(cont'd on page 17)



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Digital Digest

BITS & BYTES

by **Lacy McCall, AC4X**
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SOME DAYS ...

Some days when you get out of bed, things look great and are downhill from there during the rest of the day. Lately, in spite of my optimistic nature, the downhill is far too frequent. One of the major contributing factors to my recent experiience is what may well be a computer "virus".

That's a catchy term for the cause of the crash, and every computer I've been near lately has crashed. Twice, the death was a slow one, by steps, until no computer at all. I would really be concerned if my computers were stepping out and mingling a lot with more worldly machines, but several of the sickies have been lonely machines, trained to work in isolation. No phone connections, usually a single operator, and insulation from the real world are all part of the circumstance.

Before the last few weeks, when I read about a computer virus, I moved on quickly. No detailed reading for me, but now I am wondering. Surely there are readers (computer doctors, I presume) who know how all this happens.

Let me give you an example. I sat down to write this article and out came a beautiful flow of words for several pages. They were not these words, but different, and then zap. My normally well behaved Compaq Portable II went off into never never land. The cursor just smiled back and sat still. Even the control, alternate, delete combination did nothing. Only the power switch removed the stationary cursor. I tested the disk, I tested the memory, and most everything possible. When the tests didn't lock up, all was very satisfactory.

Don't worry about this, because I have more medicine. Once I find out about this virus business, I will report further.

CRYSTAL BALL ...

Nostradamus was an astronomer and physician who lived in the sixteenth century. His book "Centuries" is the reason he is remembered, because in it he made predictions of things to come. If it had not been for the circumstances surrounding the death of King Henry II of France, which seemed to happen as Nostradamus predicted, we would not have heard much about this man.

Now it's my time to roll the dice and see if I can predict the future. Remember, all I've got to do is correctly predict one significant thing right and I may be remembered forever. That is not too likely, but you can never tell.

Before you get carried away for the look into the future, let me explain that I am not one of those people that claim to have special powers. My secret is logic, based on watching what has happened before and tempered with a dash of human nature.

As you may recall, I have already predicted that the NO-Code license will happen; not because I support NO-Code, but because there are too many forces for change. Hang on and let's look at the future.

Initially, NO-Code will have a small burst of applicants, but will be slow to develop. However, within the first five years of the NO-Code License, there will be a significant burst of activity. This will occur because of a few significant technological advances, but more because of world events within the ham radio community. Hams will gain recognition for their activity using new technology and this will lead a lot of people to the hobby.

The accelerated growth will also be spurred by equipment makers who will be disappointed at the number of NO-Code applicants. The companies will see that they must advertise and publicize the procedure and hobby strongly to attract the numbers they need for sales growth. The results of their advertising along with the events mentioned above will make them very happy.

As part of the technology you will see a completely new transmission mode. This will have the same impact on the hobby as the introduction of Packet, and will likely be even larger because of it's simplicity and speed.

In taking a look at the people who take up ham radio as a NO-Code hobby, you will find quite a variety. Within the first five years, the statistics will look like something like this. Ten percent of the new NO-Code applicants will never contribute significantly to the hobby and will drop by the way. They may purchase one item of radio related equipment, but will not maintain their interest long enough to use it.

About eight percent will get the NO-Code license because they hate Code and could never have passed the CW exam. They will be talkers. Assuming the are not in the dropout group, they will be more of the CB inclination and use the hobby in that way. You will be able to find a lot of these people on 80 meters hanging out with some like them that are already there. Actually, this group is the one most often mentioned by those that oppose NO-Code.

Another small group will be the new technocrats. About five percent of the NO-Code group will be into the deep dark secrets buried inside all the computer and radio boxes. The hobby will offer them expanded horizons for technological exploration, and they will be of great benefit to the advancement of the hobby. The computer oriented NO-Code people will comprise the second largest group. This thirty percent will use the hobby as predicted, operating the digital modes with computer and not doing a lot of talking otherwise. They will gain strength within the ham ranks, and form separate interest groups more closely tied to their particular interests. Most of this group will subscribe to Digital-Digest. Although they will be more pointed in their use of the hobby, they will feel a strong link with all other hams. Most will be ARRL members, go to HAMFESTS and belong to local clubs.

Since the new operating mode will be one of the NO-Code attractions, about twelve percent will stay strictly with that mode. Again, it will become a special interest group and will have a cohesive nature unlike any the hobby has seen before. They will work hard to expand use of the new mode and will find great success, in enlistment of both regular and NO-Code hams.

The last thirty-five percent will be perhaps the most surprising. Even though they enter the amateur group with a NO-Code license, they will gradually upgrade. Many will hold an Amateur Extra Class License before the end of the first five years. Of this group, about a third will become infatuated with CW and become regulars on the CW portions of the band. The balance will be just about the same as before NO-Code. They will have changing interests but will have favorite spots to operate. The group, in general will be well behaved and have good on-the-air manners. Perhaps, as a group, they will be even more disciplined and gentlemanly than the 20 meter gang of 1989.

When the FCC looks back, after five years, the ARRL will agree with them that the program could be considered a success. Both will concur that changes should be made to the procedures and operating limitations. QST will publish an editorial revealing the above statistics and lauding it's guidance to the new group, taking credit for the success.

At the end of five years, with the newcomers counted and the silent-keys subtracted, the hobby will be about the same except it will be different.

So much for you, Nostradamus.

HEARD ON THE BANDS ...

Nothing. For the last couple of months, I have been completely preoccupied with more mundane duties. My rigs have been on very little and you could call me a rare contact.

Most hams go through these stages where operating either gets put aside for other things or it loses it's interest for a time. I happen to have no less interest, just a time shortage. In either event, this is probably one thing that keeps the hobby fresh for most of us. After a couple of months off the air, it will be a real treat to crank up all the gear and make a few contacts. My particular schedule looks better, so look for me on 20 meter phone in the next few weeks and you can bet that I'll be running my BBS program MPC50 for final testing using Amtor. Mostly likely that will be on twenty meters as well.

If you have lost a little of the edge, take a couple of months off and do something else. When you return, take some time to introduce yourself to Amtor or RTTY if you have never operated there. Sure, phone and CW are fun, but Amtor and RTTY are different and if you have the digital capability, don't miss the fun. A sabbatical and new mode can make ham radio a completely new and fresh hobby when you return.

FAST PHONE TALK ...

During the last month, I installed a new modem that is worthy of note. It is the "Sportster® 2400PC" made by U. S. Robotics, and is an iinternal 2400 baud modem for PC Compatible computers. With the modem, you get a handy terminal and communication program, TELPAC (tm).

Of particular interest to hams, is the TELPAC setup program which does an analysis of your computer, before installation of the modem board. During this procedure, the number of COM ports are identified. The program tells you exactly how to set the various jumpers to use the next COM port, which can be between 1 and 4. In my case, since I have COM1 and COM2, the installation program gave the information needed for installing the modem as COM3. You also are given jumper settings for most of the well known terminal programs, if you wish to use them.

The TELPAC program is simple. As I do with most new software, I ran it without spending much time with the documentation. The help in the program and prompt messages make it easy to set up the system as you desire. Using pop-down windows, TELPAC allows you to set up security levels, passwords and ID's for various callers you may have. Also, a phone directory is accessible to make dialing automatic. All the Hayes compatible AT commands are standard, although I have not tried any of the modem commands, since the program handles all modem setup and operation.

So far, I have transferred about a dozen files in the 100,000 byte range without error. I picked Xmodem protocol from several of the protocol options offered by TELPAC.

Modem prices have continued to come down in recent years and now a 2400 baud modem is much less that a 300 buad started out. The U. S. Robotic's Sportster 2400PC is reasonably priced and has worked well in all the initial tests here.

OLD FAVORITES ...

While we're discussing terminal programs, I'll mention my favorite. Beginning in the days of CP/M and 8 bit computers, Microstuf, Inc. wrote the terminal program Crosstalk®. If my recollection is correct, it was originally used not the Northstar Horizon computers. Since those days, it has seen many revisions and like Wordstar it has created quite a group of devotees.

I use Crosstalk VI for most of my connections to Compuserve or the other telephone BBS systems. It allows me to run the Quick-B protocol program for file transfers and then return to Crosstalk. Maybe you could call it an old shoe, and even though I don't have anything like the latest version of the program, it is solid, reliable and well-conceived.

In a world where any software over a year old is antique and outdated, it is a reward to have a program that does just as good a job today as my first copy over ten years ago.

FOOTNOTE ...

After completing this article on another computer, I went back to the Compaq Portable II to take it's temperature. Sure enough it had fever; bad DOS fever. A couple of aspirins and a quick copy over of a fresh DOS from a well protected diskette and all is well. From what I hear, the most likely virus target is DOS. I am not sure whether it was Command.com which is not a system file, or Ibmbios .com and Ibmdos.com which are hidden files. This time, I didn't take time to find out, but you can be sure from now on I plan to get regular check-ups.

*** Please Note ***

If you have news and information of interest to the digital amateur community, please let us know!

— Editor —

COMPUTER VIRUSES...

What they are, how they work, and how to avoid them... is a unique new combination book/disc package by Jonathan Mayo, KR3T that includes the best shareware available for combating computer viruses on DOSbased PC's.

Computer users anxious about the recent rash of computer virus infections need help in fighting the problem. It is a phenomenon of international scope, affecting everyone from the private PC owner who occasionally downloads from the local electronic bulletin board to the largest government mainframe systems.

Jon explains in clear language how PC owners can determine if a system has been invaded, identify the virus, and get rid of it with the least possible damage. Many commercial, shareware, and freeware anti-viral programs are covered and a comprehensive operating strategy is presented that will allow free use of computer capabilities while maintaining a high level of protection.

The accompanying disc contains shareware including the #1 virus-control program, FluShot +... that PC users can employ to cure their systems and protect them in the future. Published by TAB Books. For more information contact: Lea Ann Browning (717) 794-2191.

(cont'd from page 4)

11011101 ($DD) for TCP/IP stations. Other IDs may be used by ROSE or TEXNET currently, or may be assigned in the future.

The Information field contains anywhere from zero to 256 bytes of data. It usually carries normal ASCII data, and for keyboard-to- keyboard operators should contain exactly one line of no more than 80 characters plus a carriage return. Many BBSes stuff several lines into a packet (especially if the lines are short) and this field may contain straight binary data during file transfers or other operations. For TCP/IPers, their protocol is placed entirely inside the Information field.

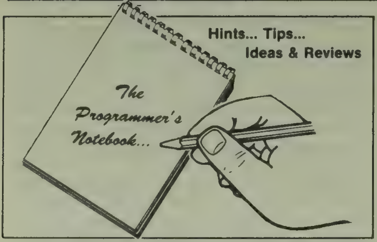
The last two bytes are the frame check sequence. This is a 16 bit number calculated by the sender. If the number calculated independently by the receiver does not match this number, an error has occurred and the frame is ignored. This prevents strange responses caused by damaged frames.

Next (and last) is the ending flag, and the end of my article for this issue. Next time we'll dig deeper into AX.25 by looking at when each of these frames is sent with some actual frames monitored over the air.

Digital Digest

*by **Peter G. Smith, N4ZR***

2003 Sarazen Place • Reston, Virginia 22091


Hints... Tips...
Ideas & Reviews
The Programmer's Notebook...

Last time, I promised some more programming in the next column, as well as a review of EASYDX, a new realtime logging program specially designed for HF DXers. This time, let's start with the review and leave the hard stuff until last.

EASYDX - A Different Sort of Review

Why different, you may ask? Well, for one thing, EASYDX isn't yet available on the market. I obtained a copy as the result of my involvement with K1EA's CT, because of a note in the documentation that mentioned, almost in passing, a K1GW logging program that could print QSL labels from CT files. The note said that the program was in "Beta" test (meaning that it had been released to a limited number of users for final debugging) and could be obtained from KC1EO. I thought that even if all it did was produce QSL labels that would be well worthwhile, so I sent for a copy.

Boy, was I surprised! EASYDX, as the K1GW program is now called, has the potential of being the single indispensable program for any DXer with a computer. First and foremost, it is a realtime logging program, but it goes far beyond that. Enter a call into the "CALL" field and you immediately get information on the standard prefix for the country, the country name, the compass bearing to that country, and sunrise and sunset times there (for grayline lowband planning), as well as a check on whether you have worked that station before, and if so, when. Enter the band and mode, and the program really begins to pay off, by telling you whether you have worked and/or confirmed that country on that band, mode, or both. It also gives you a display of ALL the bands and modes for which you have received QSLs for that country, in case you want to ask the other station to QSY for a needed band/country.

The thing that really sets EASYDX apart from the others, though, is its real-time packet cluster capability. While you are tuning across your favorite band, EASYDX can function simultaneously as a packet terminal connected to any station running the PacketCluster software. DX spots (or any other message) transmitted by the packet cluster are displayed on the screen. But here's the real show-stopper -- the program examines each incoming DX spot and tells you whether you need a QSO with the station on that band or mode for DXCC. You don't even have to be at the computer, because EASYDX will send "DX" in Morse on your computer's speaker to alert you to a new one if you're anywhere within earshot.

EASYDX also keeps track of your QSLing. You can decide at the time of the contact (or later) whether to QSL, and the program will generate a label with QSL information to put on your outgoing card. It will keep track of cards sent and not yet answered, and let you enter received cards to keep your records up to date. At any time, you can get country breakdowns or summaries of your DXCC status by mode, band, or band AND mode. And finally, as promised, EASYDX can import logs from CT, so that you ccan easily bring your contest QSOs into your DXCC activities.

Performance

In the on-disk documentation, K1GW warns prospective users that they are not dealing with a finished product, and disclaims responsibility for the loss of any data stored in it. The warning is in capital letters, repeated, and well worth heeding, because at this time EASYDX isn't yet a finished product. While it does all of the things it claims, there are several bugs, one quite serious.

Let's start with what it does right. Data entry is essentially bug-free, and the search process for previous QSOs and band/country information is quick and effortless. I have loaded over 1000 QSOs into the program, both importing from CT and entering them manually, and have never had the program crash in real time. The packet cluster interface also operates smoothly and effortlessly.

I have some qualms about the resource requirements of the program. With 1000 QSOs loaded into it, EASYDX's files (data and indices) already require over 200 KBytes of disk space. For an active ham, and particularly a contester, the disk-space needs of the program could quickly get way out of hand. One solution, of course, would be to go through after importing a contest log, and delete all the "routine" QSOs (which in any case are still available in CT log files). That way, the logger would only be used for contest QSOs that represented needed QSLs and DXing or casual operating, where the sheer numbers of QSOs are not so large.

EASYDX has one primary and one secondary problem that need attention before it can move out of the Beta test phase. First, there are serious indexing bugs in the database portion of the program, which MAY arise from the TurboAccess database engine package that K1GW has built EASYDX around. The symptoms occur in every mode where the database is accessed. I first noticed that the program would not reliably find previous QSOs with a given station. I worked the XF4L DXpedition on 20 meters one day, and the next day heard them on 20 again. I checked, and saw no record of the previous QSO, yet when I used another function to list all QSOs on that date, there it was. As time went on and the number of QSOs in the database increased, I also noticed that I was getting false indications that I needed a given country on the current band or mode. About the time it told me that I needed VE on any band or mode I concluded there was a serious problem.

The secondary problem concerns nonstandard prefixes and their indexing - it may be a subset of the same bug reported above, but compounded by a lack of clarity in the instructions for the program. When entering old QSOs to build a database for 5BDXCC, I needed to enter some nonstandard prefixes, such as VS5 for Brunei (now V8). EASYDX has a facility for doing this, but it does not always work properly. In examining the file of prefix equivalences created by the prefix indexer, it appears that the program sometimes enters new alternative prefixes TWICE, once in their proper place in the listing and again elsewhere. This, in turn, seems to confuse the indexing. In addition, K1GW's selection of "standard" prefixes is personal and sometimes somewhat arbitrary, and the user could do with some more instruction on how to update the prefix list in a way that will lend itself to tracking new QSOs later on. It would be helpful if the documentation explained the way in which the program derives prefixes from call-signs, to help the user decide what to enter as the "nonstandard" prefix. I found myself entering the full call of stations like CR7JO (old Mozambique) and CR6XX (old Angola) rather than take a chance on confusion with current Portuguese prefixes used in Madeira and elsewhere.

I mention these bugs here not to criticize the programmers -- that would be unfair, for a Beta program -- but to indicate how close EASYDX is to being a true breakthrough product. I wrote to K1GW in April and early May to report the bugs I've found, and assume that the other Beta testers have done likewise. We are all looking forward impatiently to the release of a final Beta version, and then to an open market version. If you feel as I do that EASYDX can be a unique contribution to the use of computers in ham radio, I encourage you to write K1GW or KC1EO and urge them to persevere.

Hash Plus . . .

Last time, I introduced the idea of hashing as the engine for a dupe-checker or contest logger. This time, let's look at a few ways that you can extend that idea to other applications, such as tracking countries, or prefixes, or zones, or ARRL Sections in Sweepstakes.

I call the fundamental idea "slicing". The point is to extract from a string of input the combination of characters that you need in order to track whatever you want.

Let's try a simple case -- tracking zones in CQWW. The standard exchange in CQWW is signal report plus zone. If you're in the phone contest, the signal report will always be two characters (usually "59", of course). In that case, you can use the following bit of programming to extract the zone and check it for validity.

```
10 INPUT "EXCHANGE"; XC$             XC$ is the CQWW phone
                                     exchange.

20 Z$ = RIGHT$ (XC$, (LEN(XC$)       Extract Z$ (the zone in
   -2))                              string format).

30 Z = VAL(Z$)                       Make the zone a numeric
                                     variable.

40 IF Z<1 OR Z>40 THEN               Check zone for validity.
   PRINT "ERROR": Z$="":
   Z=0: GOTO 10

50 PRINT "ZONE =";Z:GOTO 10          Print the zone and go back
                                     for another call-sign.
```

It gets a little trickier if you are trying to extract something like a prefix, for country checking or use in WPX. You need to begin by defining what you mean by a prefix. If for example, you define it as the beginning of the call-sign down through the first number in the call, you will have ambiguity among T30, T31 and T32. If you stop before the first number, then you have an even worse problem. One approach is to include the letters and ALL the numbers, then stop, but that way it will seem as if F3, F6 and F0 are all separable - that's true in WPX, but not in country-checking. Nevertheless, suppose we wanted to do it that way. Let's look at the programming that is involved, called PFXSLICE.BAS.

```
10 PX$="": INPUT A$              Input the call-sign

20 FOR I = 1 to LEN(A$):         Examine each character in the
   M$= MID$(A$,I,1)              call-sign, starting from the
                                 front.  Make it a single-
                                 character string (M$).

30 IF M$ > "/" AND M$ < ":"      If the character is a number
   THEN GOSUB 100                then go to a subroutine to de-
                                 termine if it is the last one.

40 PX$= PX$ + M$                 If the character is a letter add
                                 it to the prefix (PX$)

50 NEXT

60 GOTO 200                      In case all you have entered is
                                 the prefix alone ...

100 M1$ = MID$(A$,I,1): IF       If the NEXT character is a
    M1$ > "@" AND M1$ < "["      letter then add the numeric
    THEN PX$ = PX$ + M$:         M$ to PX$; the prefix is com-
    GOTO 200                     plete.

110 RETURN                       If not, then continue checking.

200 PRINT "PREFIX = "; PX$       Display the prefix.

210 GOTO 10                      Go back for another call-sign.
```

This listing will give you what you need to strip the prefix out of a call-sign in accordance with current WPX contest rules. Combine it with the hashing routine covered last month, and you can build a program to keep easy track of prefixes worked, either in a given contest or for an award.

One caution. Lines 30, 40 and 100 are based on the standard ASCII code table, and assume that you will enter only capital letters and numbers. The characters "/" and ":" are immediately above and below the numbers in ASCII value; similarly, the characters "@" and "(" are immediately above and below the capital letters. It is usually a good idea to incorporate a routine in your keyboard input programming so that any lower-case input is automatically translated to upper case, just in case you forget the shift lock.

That's about all I have space for this issue. Next time, another review, and a look at programming a "smart" user interface that can be used as the basis for a Sweepstakes logger perhaps the toughest contest logging challenge. See you in September!

AEA Announces New Antenna Product Line...

Advanced Electronic Applications announces its agreement with M2 Enterprises President Mike Staal, K6MYC, based in Pinedale, California, for exclusive rights to its antenna line. Mike Staal is the founder and antenna designer of KLM antennas.

The diverse M2 product line features computer-optimized antennas with the highest gain available. Other features of the antenna line include:

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ARIES-1 Hamming Software

A new review of the popular Amateur Radio Integrated Entry System

When I decided that it was finally time to put my ham logs on computer, I chose the "ARIES-1" ham software from ASHTON ITC of Vestal, New York. Here's why:

The reason for getting good hamming software is to SAVE TIME! It would have to have a superb data base for logging. It would need to automatically read the frequency and mode from my rig and the time and date from my computer. It would have to then be able to print QSL labels, allow me to view the PACKET DX spotting net at the same time, be great for contesting/dupe checking and afterwards merge the contest data into my general logs, be super convenient to use and not be obsolete in a few years. After months of checking out the many software vendors at ham conventions I finally decided on the ARIES-1 package.

Not only is it the most user-friendly ham-logging data base that I've found but it also: hooks up to all of the Kenwood and Icom rigs that have computer interfaces (most of the good ham programs do this), interfaces with terminal units like the Kantronics KAM and the AEA PK-232 (and makes using them for RTTY, AMTOR, PACKET, CW and ASCII a whole new ballgame!), prints QSL labels from your log books and then updates your logbooks showing that QSLs we're sent, has a lightning fast CONTEST MODE and a great deal more.

Save yourself a lot of frustration and head the following warning: Choosing the right logbook program the FIRST TIME is essential. Typing in all your old logs is a monumental task, and one that you want to do only once. But when you find the right program to use and once it's all in there you'll thank yourself for making the effort. Now when I sit down at the rig and find myself on qso with KB2R, I just type his call on the screen and hit a function key. ARIES-1 initiates a search thru all my logs to let me know if I've worked him before and supplies all the info about our previous contacts! I can answer with, "Hi Len..how's your daughter? She must be getting big...Are you still teaching?" You can imagine the responses. It's terrific!

To enter my current QSO with KB2R I hit another function key for "Time On". ARIES-1 enters the start time and date from the computer's internal clock. ARIES-1 checks my Kenwood TS940s and automatically shows on my screen that we're on 7.220 in LSB running 120 watts. You can either type in your power each time or set it as a default. At the end of the contact I just hit another function key for "TIME OFF". ARIES-1 then stamps the end time and adds this qso to my computer log! Easy as pie.

For the job of typing in of all your old logs there's an easy mass-entry system that makes the process as easy as it can be made to be. And this actually makes the weeks of typing in the thousands of old contacts tolerable. As a matter of fact I found re-reading and typing in each of my old contacts to be fun and full of memories!

I can now search thru any field for things like: stations that haven't QSLed, how many bands have I worked Hawaii on, who I worked during the entire day of New Year's 1983, find stations worked between 0400 and 0459 UTC, find all the guys I've ever worked who live in the San Francisco area, or all the guys I've worked on CW with the name "VLAD". The log management feature is complete and powerful.

At the end of a long contest the last thing I want to do right away is write out a couple thousand QSL cards. With ARIES-1 you just identify the contacts you want cards for and the program prints custom QSL labels calling the station's op's by their first names. There's even an open line where you can say anything you want to all the stations like: Tnx Hans fer CQWW contact. PSE QSL! or, Nce wrkng U on Century Club Late Net, Bob! And here's the kicker...you don't have to go back in the logs to re-enter that you sent a card to each person. ARIES-1 will do that for you if you tell it to.

Using my Kantronics KAM and the ARIES-1 programs I have the local packet DX-spotting board going all the time. ARIES-1 lets me do any of the KAM modes (also PK-232) at the same time I'm logging! These days it's essential or you'll miss that ZA spot when it comes over!

RTTY, AMTOR, PACKET, CW and ASCII are all a pleasure with ARIES-1 as everything is set up to use with the function keys.

ON PACKET function keys are: Connect HF or VHF, Disconnect, Command/Converse, MonRptON, Upload, Capture Buffer on/off and more!

ON RTTY AND CW function keys are: Transmit/Receive, Text files (these are beautiful! Text files are variables that are automatically filled in from your log. For example:
"NICE TO MEET YOU <NAME>, AND TNX FOR MY REPORT <MYRST> FROM <HISLOCATION> YOUR RST IS <HISRST> HERE IN BOSTON. WELL, <NAME> ... HOW PRINTING THERE?"
Other function keys include automatic call sign exchange (DL2ALB de KS1A), message buffer and more!

ON AMTOR function keys are: automatic CQ, "?", seize link, callsign exchange, selcal, message buffer and more!

I also bought MFJ's TERMINAT(tm) grey-line program. While using ARIES-1 I can instantly run the TERMINAT(tm) program and put the grey-line map on my screen with just the press of a function key! And then go right back to ARIES-1.

THE CONTEST MODE allows you to be fast and furious with data entry and dupe checking. In addition it files all pertinent data and exchanges into your log. I've used it in over 30 contests so far and am very pleased.

IN CONCLUSION: Whether you plan to interface your rig or not, the ARIES-1 is a valuable ham utility. Look around very carefully for the right program for your needs. Most of all, make sure it will handle all of your old log book data the way you want it to. I found ARIES-1 one to do the job for me very well and highly recommend it.

One more thing. The software support is outstanding. The new upgrade that new buyers get as part of the package cost me a mere five dollars, including new documentation! And, you can actually get through on the phone when you have questions. There is reason alone to buy.

(ARIES-1 is available for $89.95 from: ASHTON-ITC, PO BOX 1067, Vestal, NY 13851. Phone: 607-748-9028)

by Jim Mulvey, K1SA
- Source: CompuServe's HamNet -

Attention Software Writers...

If you've developed a new program and would like to take it to market... ASHTON ITC may have the solution to your needs!

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For complete information on the ASHTON ITC Software Marketing Program please contact: Thom Ashton, President
P.O. Box 1067, Vestal, NY 13851
Tel:(607) 748-9028.

(cont'd from page 3)

own radio system couldn't. Score one for Amateur radio.

Connecticut has done an unusual thing. The state owns six complete packet stations; radios, antennas, computers, TNCs, and software. But the system is not yet fully installed nor staffed. One station is set up at the state EOC in OEM Hq, and another was at the Area 2 OEM office in Meriden. But Meriden was without power and that office had no generator. The Area Director set up temporary operations in the National Guard Armory and a ham operator linked him to state Hq through the two-meter voice radio in his car parked outside the window.

Power was restored to Meriden by Tuesday morning so Mike Pyrch, WA1DMX, activated the packet station and we exchanged traffic preparing for damage assessment reports.

I wish I could say what a fabulous job was done by packet radio, but I can't. Our system is incomplete and lacking for operators. While phones were out in the hard hit areas, they were operating fine between OEM area offices. Damage assessment reports were transmitted by FAX, that secretaries in each office can operate.

While there are complete packet stations for each of the five area offices and state hq, and state OEM is encouraging towns to buy packet stations, there are no state staff people to install them. This is where Connecticut Amateurs are needed -- to set up and operate packet stations.

The value and potential of packet is well recognized by state officials. And the little packet activity done during the aftermath of this tornado proved it's worth. Nothing is going to replace voice nets that can tone off and broadcast to multiple addressees all at once. But the things that overload voice frequencies are just the things that are better done on packet. Damage assessment reports, casualty lists, displaced persons, complex and comprehensive messages that take forever to speak, should go at packet speed. Connecticut officials know this. They've invested in the hardware to do the job. But you know what state budgets are these days. This job simply cannot be done by staff people. OEM is a big user of volunteer services. After all, it evolved from the old Civil Defense concept. There are state statutes to safeguard volunteers while doing service to the state. But no one cares about emergency operations -- until there's an emergency.

Our last damaging tornado was October 3, 1979. And, wouldn't you know, the same mistakes were made again this year - because different people were involved. In the short space of four years, you could be dealing with a whole new set of elected officials. Emergency management is really a job of adult education.

But Connecticut offers an opportunity to establish a packet network that could score a coup for Amateur radio. Perhaps your state would, too.

by Bill Clede, K1AH

LAN-LINK 1.52...

Several readers of the last issue of D-D requested how to get more information or a copy of the LAN-LINK software. Here is the address and who to contact:

Joe Kasser, G3ZCZ, P.O. Box 3419,
Silver Spring, MD 20901
Phone: (301) 593-6136

Watch next issue for Joe's article on packet radio featuring expanded coverage of LAN-LINK operation.

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Action Between the Ham Bands...

"Hello Mr. President!..." Listening in on Air Force One has always been interesting and it's getting even more popular! The frequencies everyone are talking about: 415.700 and 407.850 on your scanner! The plane flies at an altitude of more than a few miles... so if Mr. Bush is over any of the surrounding states you're bound to pick him up. Almost all traffic is not scrambled and consists of phone patches and clearances. "CROWN CONTROL" by the way, is the White house.

Absolutely fascinating listening can be found in upper side-band on 11.076, 14.686, 18.666, 23.403. However, I can't be positive as to what it is! Lots of code names and short announcements like, "subject approaching" or "stand by, entering perimeter". The Gilfer's Confidential Frequency list has these as possible CIA/DEA/USCG. Give it a try during daylight hours. These are good freq's to have on in the shack when you're working on something else. If one freq doesn't yield something within 15 minutes try another. Whatever it is, it's fascinating.

If you have digital shortwave monitoring equipment, try watching RTTY on 6456.78 at 170 shift, 75 baud, reversed (170/75R). I've been watching interesting english traffic of scientific nature . . . "Science support expedition" is the only ID! Try around 1000-1030 UTC.

Kenwood U.S.A. now has it's very own computer bulletin board. Reach it at 300/1200/2400 baud at 1-213-761-8284. Open 1700-0800 pst M-F and Fri 1700 to 0800 pst Monday.

The BBC brags the largest, most extensive record library in the world. Once a week they dive in and play a half hour of terrific music of all types, on the same show! IT'S always FUN and there's always something you'll remember as the week goes on. Join the growing cult following that listens to "Anything Goes" on the BBC! Sunday night in the states (Monday morning UTC) at 0330 UTC on any BBC world service freq!

Want to find out a lot more about Short Wave Listening? NASWA is a great club that puts out a high quality monthly magazine full of what you want to know. write to them at: 45 Wildflower Road, Leitton, PA 19057.

Thanks to everyone who worked us, the Billerica Amateur Radio Society (BARS) on Field Day (call KS1A)! Look for another SWL show on the ABC Talkradio Network heard all around the country... August 12th with Ray Briem!

by Jim Mulvey, KS1A
- Source: CompuServe's HamNet -

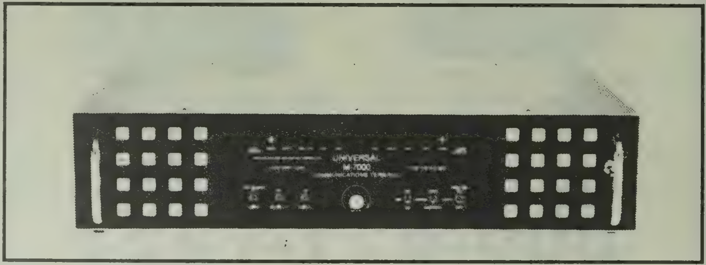
AMATEUR RADIO OPERATING SYSTEM...

is a new modular software system for IBM-PC and PC compatible computers developed by Ron Stange, WA4PYF. Not just another "ham" computer program, the Amateur Radio Operating System (ARS) is a full function software package for the novice as well as the seasoned amateur radio operator. The ARS software is offered in functional modules. After the BASE module is purchased, you need only obtain those modules that support your own "ham" field of interest.

The author has been a ham for over 25 years and has earned many operating awards including DXCC, WAS, and WAZ. During those same 25 years, WA4PYF was in the data processing industry. He has 18 years with IBM Corporation as a field service engineer and seven years with Paradyne Corporation as a product development manager and quality assurance director.

(cont'd on page 17)

Monitor More With the New Universal M-7000!



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✦ ASCII Variable Speed
✦ Sitor Mode A (ARQ)
✦ Sitor Mode B (FEC)
✦ ARQ-E & ARQ-E3
✦ ARQ 2&4 chan. (TDM)
✦ VFT Modes (FDM)
✦ Russian 3rd Shift Cyrillic
✦ Facsimile (FAX) AM
✦ Facsimile (FAX) FM
✦ Packet 300/1200 AX.25
✦ Literal Mode
✦ Databit Mode
✦ Diversity Reception
✦ Dual Metering
✦ Low Tone & High Tone
✦ Variable & Standard Shift
✦ Speed Readout
✦ 4 TTY Alphabets
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(cont'd from page 9)

Bell 202 standard modem are still found as surplus items as hamfests for very low prices. The Bell 202 standard uses 1000 Hz shift with mark and space tones at 1200 Hz and 2200 Hz. They can handle the standard 1200 baud rate of VHF packet radio, and are easy to calibrate and use.

The Bell 202 modem was implemented in packet radio for use with 2-meter FM transceivers. The modulation method used is AFSK at 1200 baud. Bell 202 modems are the type found on most onboard TNC modems. The Bell 202 modem usually uses a phase lock loop (PLL) demodulator. A PLL demodulator works by utilizing a phase detector along with a voltage-controlled oscillator (VCO) in a feedback circuit. A direct current feedback voltage is generated proportional to the difference between the received audio and the VCO. This voltage changes as needed to adjust the VCO to the same frequency as that which was received. Therefore, the voltage will vary as the input audio frequency alternates between mark and space conditions. This varying voltage is then filtered and amplified to produce the required mark and space signals.

There are several disadvantages to using PLL demodulators. One is that they tend to lock onto the strongest signal in their lock range, often ignoring weaker signals that you might be trying to copy. Another disadvantage is that a PLL has no variable tuning indicator, so it must be tuned by ear in conjunction with a single LED which lights when a signal is tuned in. However, these disadvantages are not too important on VHF and UHF packet radio. The fact that the PLL tends to lock onto the stronger signal is useful if two stations transmit at the same time. The stronger signal might be received correctly, thus avoiding a complete collision. And since most packet activity on VHF and UHF takes place on preassigned frequencies, tuning is not a major issue.

For HF operation, shift filter based modems are usually used. The filters are tuned for particular shift frequencies and come in two different varieties: passive and active. A passive filter is a simple LC resonant circuit whose band-pass is preadjusted to pass the necessary frequency pairs. An active filter system (either discrete transistors or integrated circuits) may utilize feedback filters or switched capacitor filters to provide the desired band-pass characteristics.

Because of the characteristics of HF operation, different modem configurations have been developed for packet transmission. 300 baud (A)FSK with a 200 Hz shift is the usual standard. If AFSK is being used, the lower sideband (LSB) is chosen. On 10 meters, the Bell 202 standard is sometimes used.

Although Bell 202 on VHF is the mainstay of packet activity, other forms of modulation have been under development and will see increased usage in the future. 400 baud FSK is being used for amateur satellite activity. 9600 BPS PSK and FSK modems are under development for high-speed linking, and very high-speed (56,000 BPS) modems are under development for real time digitizing of voice and video.

(cont'd from page 16)

The base module of the "Amateur Radio Operating System" can be ordered directly by sending a check or money order for $39.95 plus $2.00 shipping and handling to: Fundamental Services, Dept. R, 1546 Peaceful Lane N.
Clearwater, FL 34616

Florida residents must add $2.40 sales tax. Demonstration diskettes are available for $10.00 which is discounted on the next purchase.

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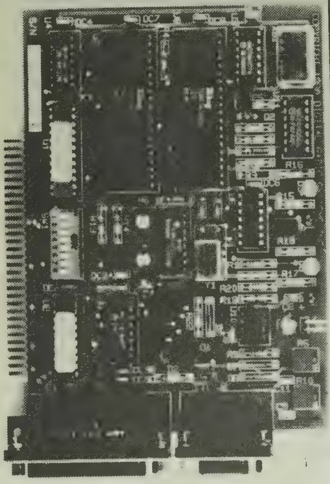

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Digital Digest

COMPUTERS

by **Jonathan L. Mayo, KR3T**

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RS-232 C & D Standards

While the RS-232 communications standard was originally developed in the late 1960s, it remains the standard interface specification for serial asynchronous communications equipment. Other standards have been developed which have advantages over RS-232, but the new standards have failed to supplant RS-232 because of its widespread use. The reason we, as amateur radio operators, are concerned with the RS232 standard is because most microcomputers and terminals as well as TNCs, multi-mode units, and other modem devices that are used in amateur digital communications support RS-232 communications.

In serial asynchronous communications, digital signals are sent as groups of a specified length sequentially on a single channel, and uneven intervals between transmissions are allowed. The digital signals usually represent characters in text. There are several standardized codes in use today for the transmission of text data; ASCII (American Standard Code for Information Interchange) is the most common.

At first the RS-232 standard may seem a blessing because it seems to solve our serial communication needs very easily. After all, if two units each support RS-232, we can just wire them together and they will work; no problem. However, it is not that easy. Some so-called "RS-232 compatible" devices are not really very compatible. Compatibility is a matter of degrees; some devices are more compatible than others. This is definitely the case with most RS-232 implementations.

Some devices only support a subset of the RS-232 standard. Others vary pin assignments or voltage levels to meet their own requirements. Because of these potential problems, this article examines what the standards really standardize.

The RS-232 standard will most probably be encountered when connecting your hardware packet TNC (Terminal Node Controller) or other digital modem device to your terminal or computer. Should you run into problems with the interface, a thorough understanding of the RS-232 standard will help you in diagnosing the problem and coming up with a solution. A knowledge of the standard can also be very helpful when wiring RS-232 cables.

Introduction

The proper name for the RS-232 standard is "Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange." The standard was developed by the Electronic Industries Association (EIA) and the latest version is D; thus the reference to RS-232D. However, because version D of the RS232 standard is relatively new, you will continue to see references to version C for the foreseeable future. CCITT (Comite Consultatif Internationale de Telegraphique et Telephonie) Recommendation V.24 is almost identical to the RS-232C standard. This article will concentrate on the RS-232C standard because that version is currently being referenced by most microcomputer and peripheral manufacturers.

The RS-232C standard covers four main areas. The first is the mechanical characteristics of the interface. The second is the electrical signals across the interface. Third is the function of each signal. And fourth is the subsets of signals used for certain applications.

Data Terminal Equipment (DTE) and Data Communications Equipment, sometimes referred to as Data Circuit-terminating Equipment, (DCE) are the two device classifications in RS-232. A DTE is a terminal, a computer, or any device capable of transmitting and receiving data. A DCE is a device that establishes, maintains, and terminates a connection. A DCE also provides any necessary signal conversion between the data it receives from and sends to the terminal and the data it sends and receives over the communications channel. Telephone modems and packet radio TNCs are DCE devices. We will learn more about the physical differences between DTEs and DCEs later in this section.

There is no specific connector in the RS-232C standard. However, the DB-25 connector is most commonly used and is now included in the RS-232D standard. Virtually all hardware TNCs use the DB-25 connector as the port for terminal communications. The DCE usually has the female connector, DB-25S (Socket). The maximum recommended cable length is 50 feet and the maximum cable capacitance is 2500pF. Cable runs of greater than 50 feet are appropriate provided the load capacitance measured at the interface point and including the signal terminator does not exceed 2500pF.

Signals

RS-232 electrical signals and their functions are referred to by four different systems: pin number, EIA designation, CCITT designation, and abbreviation of signal description. The following paragraphs provide information about the electrical signals most encountered when interfacing a DTE terminal to a DCE device. Fortunately, the full set of RS-232 signals is rarely used; so we are able to overlook numerous signals without worry.

Pin 1 is referenced by the EIA as AA, the CCITT as 101, and the abbreviation GND. It serves as the chassis ground between the two devices. However, it should not be depended on for shock protection. But, this pin should definitely be connected at each end because opening in the chassis ground can cause problems that are very difficult to trace.

Pin 7 is referenced by the EIA as AB, the CCITT as 102, and the abbreviation SG. It serves as the signal ground. Pin 7 is the reference for all other pins and completes the circuit for the flow of current.

Pin 1 and pin 7 are the only two ground pins. Both should be connected; however, in most devices, pin 1 and pin 7 are connected to the same ground in the equipment. Thus it is usually possible to get by with only one of the two connected. If there are separate chassis and signal grounds, and pin 1 is not wired and the ground at each device is at different potentials, current may flow through pin 7 and possibly interfere with data flow.

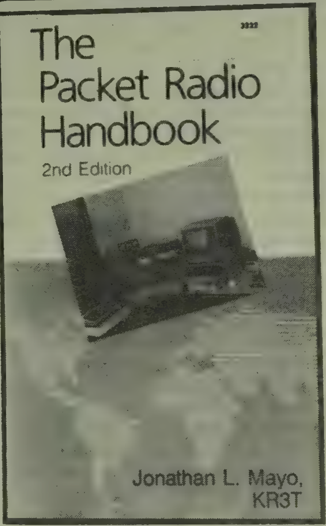
In version D of the RS-232 standard, pin 1 is defined as Shield and should not be connected to the interface. In version D, pin 1 is used to permit shielding of the interface cable. Pin 7, the signal ground, is the only ground connection that should be made in the interface cable when using version D.

Pin 2 is referenced by the EIA as BA, the CCITT as 103, and the abbreviation TD. This pin serves as the Transmit Data pin. All information sent via the RS-232 port comes out on this pin.

Pin 3 is referenced by the EIA as BB, the CCITT as 104, and the abbreviation RD. This pin serves as the Receive Data pin. All data received via the RS-232 port comes in on this pin.

These descriptions are viewed from the DTE. DCE sends data on pin 3 and receives on pin 2. Thus the DTE transmits on pin 2 and the DCE receives on pin 2, and the DCE transmits on pin 3, and the DTE receives on pin 3.

Pin 4 is referenced by the EIA as CA, the CCITT as 105, and the abbreviation RTS. This pin serves as the Request To Send indicator. When the DTE has data to send, it asserts the RTS.



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Pin 5 is referenced by the EIA as CB, the CCITT as 106, and the abbreviation CTS. This pin serves as the Clear To Send indicator. The DCE asserts the CTS when it is able to receive data from the DTE. According to the standard, the CTS may only be asserted after receiving a RTS from the DTE.

Pin 6 is referenced by the EIA as CC, the CCITT as 107, and the abbreviation DSR. This pin serves as the Data Set Ready indicator. It is asserted as a response to the DTR signal and indicates that the DCE is ready for operation.

Pin 20 is referenced by the EIA as CD, the CCITT as 108/2, and the abbreviation DTR. This pin serves as the Data Terminal Ready indicator. The DTR indicates that the DTE is ready to send and receive data. The DTR is asserted whenever the DTE has data to send, or in some cases whenever the terminal is operating.

Pin 8 is referenced by the EIA as CF, the CCITT as 109, and the abbreviation DCD. It serves as the Data Carrier Detect (or just Carrier Detect) indicator. The DCE asserts this pin when the communications channel is ready. Many DTE will not transmit or receive data unless this pin is asserted. In some cases, pin 8 is wired to pin 20 so it is always asserted.

When the RS-232C standard is properly implemented, data will not be transmitted unless the RTS, CTS, DSR, DTR, and DCD pins are asserted. There are many other RS-232C signals, 20 in all, but the ones listed above are the most commonly used.

Signal Levels

RS-232 signal voltages are not compatible with those utilized by most computer circuitry, so an additional power supply is incorporated in RS-232 equipment to provide the necessary voltages. RS-232 signals are referenced to the pin 7 signal ground. The positive voltages can range from 5 to 25 volts. On pins 2 and 3, a positive voltage indicates a logic 0 level. The negative voltages range from -5 to -25 volts. On pins 2 and 3, a negative voltage indicates a logic 1 level. The polarities are reversed for the control line logic levels with a logic level 1 meaning the pin is asserted on. When transmitting, voltages of '12 and -12 volts are usually used by most devices. When receiving, the positive voltage must be greater than 3 volts and the negative voltage must be less than -3 volts in order to be correctly interpreted by the receiving circuitry.

Cable Configurations

The following section describes several examples of RS-232 cables for a variety of applications. These may be of help when wiring your own cables or attempting to diagnose problems with your cable and interface.

Minimum Cable

In a minimum RS-232 cable as few as three pins may be connected. This is very convenient for use in lengthy cable runs. Pins 1(GND), 2(TD), 3(RD), and 4(SG) are connected (See Fig. 1). If the signal and chassis ground are connected in the equipment, only one pin is necessary; pin 1 is usually chosen. In order for this cable to work, the RTS/CTS and DSR/DTR pairs must be ignored. If a piece of equipment will not work unless a pin is asserted, just wire it directly to the voltage required. Software flow control must be used with this three wire cable; more on flow control later.

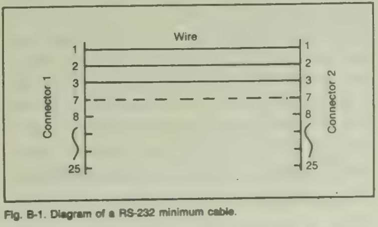

Fig. B-1. Diagram of a RS-232 minimum cable.

Full Cable

This cable should provide all connections necessary for most RS232C applications. The following pins should be connected: Pin 1 or pin 7, pin 2, pin 3, pin 4, pin 5, pin 6, pin 8, and pin 20 (See Fig. 2). This cable works in most situations and allows for hardware flow control.

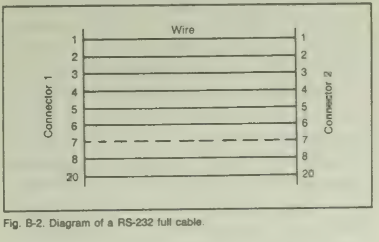

Fig. B-2. Diagram of a RS-232 full cable.

Null Modem

A null modem adapter allows two DTEs or DCEs to communicate with each other. Several pins must be reversed to allow the proper signals to reach the proper pins (See Fig. 3). If you recall from the signal descriptions of pins 2 and 3, a DTE transmits on pin 2 and receives on

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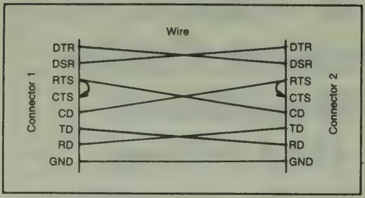

Fig. B-3. Diagram of a RS-232 null modem.

pin 3 and a DCE transmits on pin 3 and receives on pin 2. So when connecting two devices of a like type, these pins must be cross-connected so that one device's pin 2 is wired to the other device's pin 3 and the first device's pin 3 is wired to the other's pin 2. This allows the two devices to transmit and receive on their proper pins.

The RTS of each device should be wired to its own CTS and to the DCD of the other device. This allows a Request To Send to receive an instant Clear To Send and also asserts the Data Carrier Detect so the other device knows a transmission is coming. Additionally, the DTR and DSR pins must be cross-connected in the same manner as the TD and RD pins to allow for proper signaling. The pin 1 and 7 grounds are wired straight through as usual.

This null modem adapter is useful when transferring files between two computers or when connecting a computer to a printer that is wired as a DTE. It can be incorporated into a cable by switching the cable wires or through an adapter which is inserted into the cable.

Flow Control

Flow control is one of the potential problem areas of the RS-232 interface. Flow control is the process of stopping and starting the flow of data between devices. Flow control can be implemented in hardware, using the interface's signals, or in software. Under software flow control, the data flow is controlled independently of the physical interface.

The RS-232 standard was not designed for hardware flow control. Rather, it expected all flow control to be provided through software. One method of software flow control, known as X-on/X-off, works by sending control characters over the physical interface. However, many computer manufacturers have attempted to control the flow of data between the devices though use of the RTS/CTS and DTR/DSR pairs. This has been accomplished with varying degrees of success with printers and modems, and has been carried over to packet radio TNCs and other amateur digital communications interfaces. According to the RS-232 standard, the DCE is not allowed to drop the CTS until the DTE drops the RTS. The DCE should not drop its CTS at random for flow control. The proper use of the RTS/CTS pair is to allow the terminal to request use of the communication channel. However, hardware flow control using these pins is possible. Many TNCs don't have full RTS/CTS capability, so they may be used for flow control if the terminal will allow it, and most terminals will. Another approach, DTR/DSR flow control, works by turning off the DSR pin when the device can accept no more data.

There is no guarantee that hardware flow control will work, but it usually does. There are many problems that can occur when using hardware flow control such as when to stop accepting data, what to do with a character that is partially sent when the device is told to stop sending, and when and at what character to resume sending. Check the terminal and TNC manuals carefully if you are planning to implement hardware flow control. For general use, it is usually best to stick with X-on/X-off software flow control.

Non-Standard Implementations

Another problem that can pop up when working with RS-232 "compatible" devices is non-standard voltage levels. Instead of utilizing the standard +12 and -12 volts, some equipment use voltages such as +5 and -5 or +5 and 0. Depending on how sensitive the RS-232 devices are to voltage levels, these non-standard voltage levels may or may not work. In most cases they usually do.

Non-standard pin assignments are yet another problem that may be encountered. Some TNCs have other uses assigned to some pins other than as specified by the standard. These pins are usually not used for I/O (Input/Output) and are usually ones that are not commonly used by most devices. These pins may have strange voltages on them or may be used as special control lines. It is a good idea not to connect these pins unless you are certain they will not interfere with the data transmission or damage any equipment. Check the manuals for more specific information about a particular pin's function.

Limitations

While the RS-232 standard has been a great aid over the years in standardizing serial data communication between devices, it does have many limitations. These limitations are usually not of concern to us as amateur radio operators, but they should be considered when working with RS-232 communications.

The maximum recommended cable length of 50 feet is not often found to be very limiting for amateur digital communications applications. The value of 50 feet is derived by dividing the maximum capacitance of 2500pF by the capacitance of a foot of cable which is usually about 50pF. The cable length can be increased through the use of shielded cable and in-line amplifiers.

The fact that the voltages utilized by RS-232 are not the same as those used to power most computer components requires the addition of another power supply.

RS-232 utilizes what is known as an *unbalanced ground.* There is only one signal ground for all the pins, and a difference in ground potential at each end can change the allowable voltage detection range. Because of this signal detection errors may occur.

Despite these drawbacks, the RS-232 standard is fine for limited distance, medium speed applications such as microcomputer communications.

Wiring Cables

Wiring your own RS-232 cables can save you a great deal of money over the price of a completed cable, and you can modify the cable to meet your own needs very easily. There are three main decisions to be made when wiring RS232 cables: connector type, cable type, and number and type of pins.

The most common RS-232 connector is the DB-25. The DB-25 connector comes in several varieties. You must first determine whether your equipment needs male or female connectors. The male connector is known as DB-25P (Plug), and the female connector is known as DB-25S (Socket). Each plug comes in two varieties: solder type and friction type.

With the solder type, individual wires are soldered to each needed pin. The cable can be composed of individual wires, usually a 4-5 wire ribbon cable, or 4 wire telephone cable. Hoods are protective covers designed to fit over the back of the solder type DB-25 connector and provide a convenient handhold for plugging and unplugging the connector.

The friction type, also called insulation displacement, connectors are for use with ribbon cable; usually 25 wire. The cable is simply placed in a slot on the back of the connector, and the connector is compressed. Connector pins puncture the ribbon cable's insulation and make contact with the wires. Friction connectors provide a convenient means to quickly wire all 25 pins.

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When constructing a cable, it is a good idea to always add an extra foot or so of cable. This makes rearranging the station much easier by not tying the TNC down to one particular location.

Conclusion

The RS-232C and RS-232D standards can be a pain to work with and diagnose if not working properly. But, in most cases, the interface works fine the first time. If you already have a RS-232 connection to a modem or other device, simply substitute the TNC (or whatever device you are using) for that device and everything should work fine.

Should you have problems with a RS-232 interface, it is important to determine whether the interface cabling, the TNC, or the terminal's hardware and/or communications software is at fault. If the fault is isolated to the interface cabling, the information in this article should make finding and solving the problem a little easier.

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A more complete description of his experiments appeared in January 1896, and on March 12 (24 N.S.) of the same year he gave a further demonstration before the same society. Only a very brief minute appeared at the time in the records of the society: "A. S. Popoff shows instruments for the lecture demonstration of the experiments of Hertz. A description of their design is already in the Zh. R.F.Kh. Obshchestva." At that meeting the words "Heinrich Hertz" were transmitted by wireless telegraphy in Morse code and similarly received before a distinguished scientific audience. To the Soviet Union, Popoff has become the inventor of the radio, May 7 being celebrated each year as "Radio Day".

In view of the date of Marconi's first patent (it was applied for on June 2, 1896, the specification was completed on March 2,1897, and it was accepted on July 2,1897), there has in recent years been much discussion about the priority of the invention of radio. We have already seen a similar case in the invention of the telephone, when only a few hours separated the filing of a caveat and a patent application by Gray and Bell. In Germany, Reis is considered "Der Erfinder des Telephons" as it is recorded on his memorial statue.

Most historians of science and technology take the view nowadays that, given the right preliminary stimulus here the work of Hertz and the lecture by Lodge - and the availability of the right materials and equipment, then a given invention might well be made simultaneously by more than one research worker. Once more looking back, but to the history of the early telegraph, we found that it was not only the act of invention that counted in technology, but also the successful communication of the idea, so that it could be applied and brought to fruition. There can be no doubt that in the case of radio, Marconi invented a system of highly successful wireless telegraphy, and that he personally inspired and supervised its application until it spanned the world. This must be considered as ample justification for his award, in the year of 1909, of the Nobel Prize for Physics. He shared it with Carl Braun (1850-1918) "in recognition of their contributions to the development of wire-less telegraphy," to quote the official citation of the Nobel Foundation at the time. Braun will always be remembered for his development of the cathode ray tube, the direct ancestor of the kinescope and the television tube, quite apart from his other work in radio.

Marconi, at the age of twenty in 1894, was well acquainted with the work of Hertz, Branly, Lodge and Righi. As the son of a rich country gentleman, his education had been private, and his main interest lay in science and music. He began experimenting in the spring of 1895 on his father's estate at the Villa Grifone, near Pontecchio, Bologna. The idea had occurred to him that Hertzian waves might be the basis for a means of communication, signalling with them the dots and dashes of the Morse alphabet. Once he had convinced his father of the practical nature of his ambition, he received from him all the financial support he needed.

In his first experiments, he used an ordinary spark induction coil and homemade coherers of the Branly type (see below). To turn the discharge on and off, he placed a telegraphy key in the primary circuit of the induction coil, and thus produced short or long trains of sparks. He could soon detect these dots and dashes all across the room, and in the summer of 1895 he moved out into the garden. In order to increase the performance and range of his transmitter, he followed previous experiments by others.

He attached to one end of his transmitter circuit an elevated metallic object, the antenna, and to the other end a metal plate buried in the ground. He could now signal across the whole garden, and he soon found that there was a direct relationship between the height of the antenna and the distance of transmission.

Marconi made important improvements in the components of his system, particularly in the design of his coherers. He also put a relay in series with it, which actuated the tapper of his coherers, and worked a telegraphic printing instrument to record the received signals.

Here is perhaps the best place to pay tribute to Edouard Branly (1844-1940), a great French physicist, officially described in France as "Inventeur de la Telegraphie Electrique sans Fil". His great contribution was the discovery of the coherer, that small fragile glass tube, looking like a thermometer, but filled with metal powder. He demonstrated it before the French Academy of Science, to which he was later elected, in 1891.

Branly found that electromagnetic waves, produced as much as 25 meters away from it, caused the individual metal particles in his coherer, first iron and later nickel and silver, to cohere and thus allow the passage of a current through them. A galvanometer was the instrument he used to show this effect. Marconi improved this greatly by using a telegraph printer. But the metal particles had to be separated again, and therefore an electric tapper, a tiny hammer precisely like that used in any electrical bell was added to the coherer. When it struck the glass tube it decohered the particles again, and thus stopped the current from the batteries.

Each successive impulse reaching Marconi's antenna produced the same phenomena in the coherer, first the coherence of the particles, then their decoherence, and hence the recording of the dots and dashes. Marconi used tightly fitting silver plugs in his glass tube, which he evacuated and sealed and thus the coherer became the first of many sensitive devices to receive wireless telegraphy. Before Marconi left Italy, to continue his work in England, he had reached a transmission distance of the order of 1 kilometer.

Such then is the story of the many inventors of wireless telegraphy, working with each other's equipment, adding new ideas and new improvements to them. It was a patient, persistent and often discouraging inquiry into natural laws and in these initial stages it was indeed only animated by the love of knowledge.

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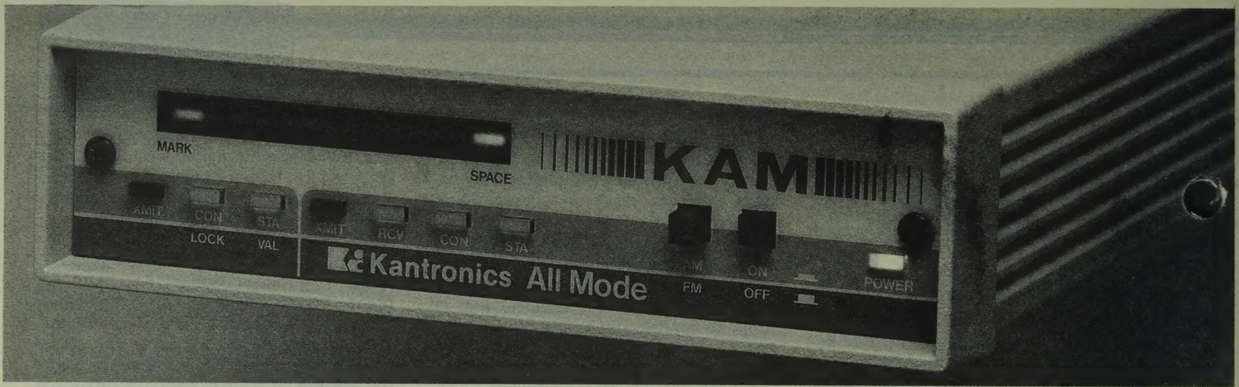

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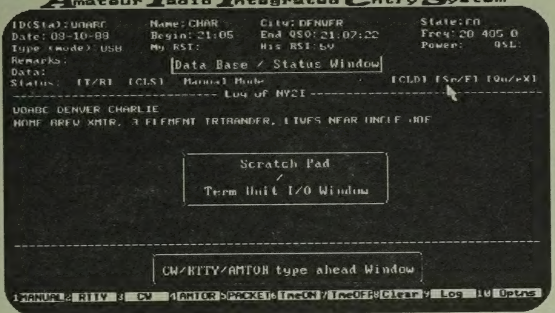

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Data:                        Data Base / Status Window
Status:   [T/R]  [CLS]   Manual Mode                    [CLD] [Sr/F] [Qu/eX]
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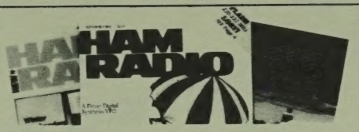

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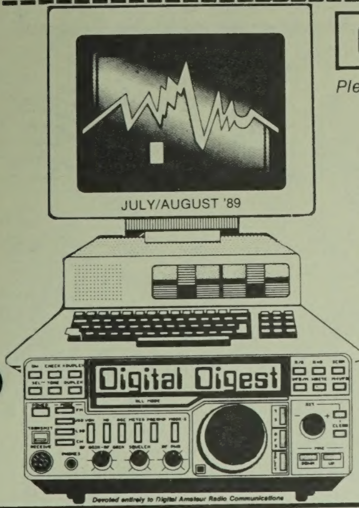

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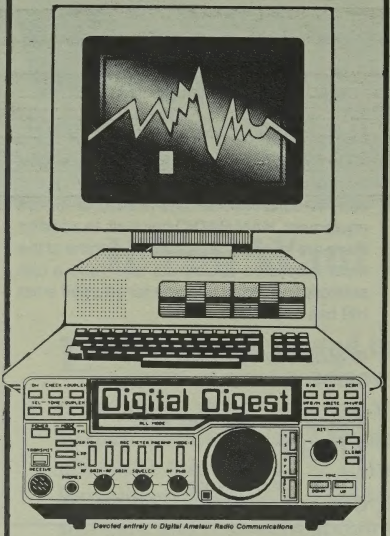
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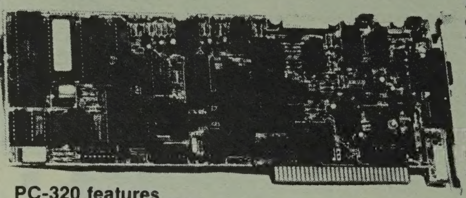

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